

## SAN FRANCISCO FORECAST DISTRICT.

Pleasant weather prevailed on the Pacific coast during the greater part of the month. From the 22d to 25th unusually warm weather prevailed in California. On the 24th the maximum temperature exceeded 115° at many points in the interior of the State. At Mount Tamalpais a temperature of 100° occurred, exceeding by 4° the highest on record at that station.—*A. G. McAdie, Professor.*

## PORTLAND, OREG., FORECAST DISTRICT.

A storm of marked severity crossed this district during the night of the 14th, for which warnings were issued six to twelve hours in advance. The wind was the heaviest on record for this season of the year. At the new North Head Weather Bureau station at the mouth of the Columbia River the maximum velocity of wind was 72 miles an hour from the southwest. No marine casualties were reported, but wheat and barley in the interior were damaged to the extent of over \$100,000.—*E. A. Beals, Forecast Official.*

## AREAS OF HIGH AND LOW PRESSURE.

Movements of centers of areas of high and low pressure.

Number.	First observed.			Last observed.			Path.		Average velocity.	
	Date.	Lat. N.	Long. W.	Date.	Lat. N.	Long. W.	Length.	Duration.	Daily.	Hourly.
<b>High areas.</b>										
I.....	*30, p. m.	39	95	3, a. m.	32	65	1,875	2.5	750	31.2
II.....	8, a. m.	47	125	11, p. m.	39	75	2,500	3.5	714	29.8
III.....	14, a. m.	44	103	17, p. m.	27	80	2,650	3.5	757	31.5
IV.....	17, a. m.	54	121	23, a. m.	38	80	3,200	6.0	533	22.2
V.....	30, a. m.	50	107	31, p. m.	46	87	1,100	1.5	733	30.5
Sums.....							11,325	17.0	3,487	145.2
Mean of 5 paths.....							2,265		697	29.0
Mean of 17 days.....									666	27.8
<b>Low areas.</b>										
I.....	2, p. m.	43	91	4, a. m.	46	60	1,600	1.5	1,067	44.4
II.....	11, a. m.	53	122	14, a. m.	47	65	2,800	3.0	933	38.9
III.....	12, p. m.	51	114	17, a. m.	46	60	2,900	4.5	644	26.8
IV.....	14, p. m.	50	120	18, a. m.	45	64	2,875	3.5	821	34.2
V.....	15, p. m.	54	114	22, p. m.	41	70	2,550	2.5	1,020	42.5
VI.....	16, p. m.	38	105	23, p. m.	41	70	2,050	6.0	342	14.2
	26, p. m.	51	114	28, p. m.	45	100	800	2.0	400	16.7
Sums.....							15,570	23.0	5,227	217.7
Mean of 7 paths.....							2,224		747	31.1
Mean of 23 days.....									677	28.2

\* June.

For graphic presentation of the movements of these highs and lows see Charts I and II.—*Geo. E. Hunt, Chief Clerk Forecast Division.*

## RIVERS AND FLOODS.

The features of the month were the local floods in the Mississippi River and its tributaries in the States of Iowa and northwestern Missouri and the very destructive overflows of the rivers of eastern Texas. The Mississippi rise was almost entirely a Des Moines River flood, and extended only from Keokuk, Iowa, to the vicinity of Louisiana, Mo. It was due to heavy local rains in the Des Moines Valley on the 8th and 9th, supplemented by a downpour on the 13th in the lower Des Moines Valley and along the Skunk River, and again from the 17th to the 19th by general and heavy rains over Iowa. On the 10th the Des Moines River at Des Moines reached a stage of 21.0 feet, 2 feet above the danger line and within 1 foot of the traditional high stage of 1851. At Ottumwa, Iowa, the same river on the 14th reached a stage of 17.9 feet, 7.9 feet above the danger line. On the Mississippi River the

maximum stages were as follows: Keokuk, Iowa, 15.5 feet on the 21st, 0.5 foot above the danger line; Hannibal, Mo., 16.6 feet, 3.6 feet above the danger line. The warnings for this flood were timely and accurate and of great benefit to the persons affected. The following report thereon was made by Mr. F. Z. Gosewisch, official in charge of the United States Weather Bureau office at Keokuk, Iowa:

On July 9 the Des Moines office reported the river stage at that place to be 11 feet, a rise of 2 feet in twenty-four hours. This information was immediately bulletined and given to the railroads, and at the same time special reports were called for. The stage of the Mississippi at Keokuk was then 7 feet, sufficiently low to allow any rise from the Des Moines to run out rapidly. On the 9th Des Moines reported a further rise of 4.7 feet to 15.7 feet, and the stage at Ottumwa, Iowa, was 7.8 feet. Bulletins were issued as before, and special warnings were given to those interested in bottom lands that a further rise of 4 or 5 feet might be expected. The canning and pickle companies placed men at work to protect their lands, levees were inspected and strengthened where weak, and all preparations made to prevent any avoidable damage.

Further forecasts of continued rises were made on the 10th and 11th, but on the 12th notice was given that the crest had been reached and that from that time the waters would recede. At this time a personal inspection of the threatened district near Keokuk showed that, owing to the precautions taken as a result of the warnings, the overflow had been confined to a very small portion of the lowlands. All danger was then assumed to be past, but subsequent events proved that this was only for a day. The heavy local rains in the lower Des Moines and Skunk watersheds started another rise in the lower Des Moines, which by the morning of the 14th reached a stage of 17.9 feet, 7.9 feet above the danger line at Ottumwa and a rise of 6.3 feet in twenty-four hours. At the same time the upper Des Moines continued to fall. The following forecast was issued: "The Mississippi will rise slowly south of Keokuk. An unexpected rise developed in the Des Moines between Des Moines and Ottumwa during Saturday night and that river will rise at Keokuk for the next twenty-four hours." By the afternoon of the 14th thousands of acres of standing crops in the Des Moines bottoms below Keokuk had been overflowed, with the river still rising.

By the 17th both the Mississippi and the Des Moines rivers were falling rapidly, but, as before, heavy rains on the succeeding day checked the fall, and another sharp rise was speedily inaugurated. The following warning was at once distributed along the Mississippi as far south as Quincy, Ill.: "Heavy rains on the Des Moines, Skunk, and Iowa. The Mississippi will rise. Probably dangerous."

Supplementary forecasts were issued on the 18th, and by the afternoon of the 19th Fox Island, a large tract of unprotected corn land, lying between Alexandria, Mo., and the mouth of the Fox River, was overflowed to the depth of 1 foot, the water on the Keokuk gage then showing 14.5 feet, with the Des Moines water level higher than that of the Mississippi. The crest of 15.5 feet at Keokuk was reached on the 21st, and after that time the recession was steady.

An accurate estimate of the damage can not be given. Many thousands of acres of fine corn were overflowed, and the total losses will doubtless aggregate several hundred thousand dollars.

At Hannibal, Mo., the river was above the danger line from the 15th to the 26th, inclusive, with a maximum stage of 16.6 feet on the 23d, 3.6 feet above the danger line. The estimated loss to crops and farm implements from La Grange, Mo., southward to Louisiana, Mo., was \$125,000, or about 65 per cent of the value of a total crop on the inundated lands.

From below Louisiana to the mouth of the Illinois River the situation was not dangerous, although somewhat alarming between the 23d and 26th.

Nothing special occurred along the Missouri River as far as stages were concerned, although some high water was experienced between Kansas City and Boonville, Mo., due to the heavy rains of the first two weeks of the month over the lower Missouri Valley, the greater portion of the water coming from the Kansas River. At Kansas City on the 14th and 15th the stage of the river was 23.2 feet, 2.2 feet above the danger line. Warnings were first issued on the 8th, and daily thereafter until the waters began to subside. No damage of consequence was reported.

The Illinois River also contributed a generous share to the flood disturbance, causing great inconvenience and some considerable damage along its course, the upper portion especially. At Peoria, Ill., a stage of 21 feet was recorded on the 22d, 7 feet above the danger line.

The lower Mississippi, Ohio, Tennessee, and Cumberland rivers, owing to the unusual amount of rainfall, were at times much above the usual summer stages, but no danger lines were reached. A similar condition of affairs prevailed along the Susquehanna River.

The Texas floods were of a very destructive character, and the warnings issued in connection therewith were a sufficient evidence of the efficiency of the Texas flood service which was established but two years since. The following report on this flood was prepared by Mr. E. H. Bowie, official in charge of the United States Weather Bureau office at Galveston, Tex.:

Conditions render it extremely difficult to arrive at an approximate monetary value of the property loss sustained as a result of these floods, but from reports by crop correspondents, press notices, etc., \$5,000,000 is considered a conservative estimate of the damage to the State as a whole from prolonged inundation of crops, loss of bridges, houses, railway tracks, etc., and suspension of railway traffic. That the loss was not greater is due in a large measure to the ample period available for protection of property between the time that the warnings were issued and the advent of the floods. A number of lives were lost in different parts of the State, the total number reported by the press being sixteen.

In the dissemination of the warnings issued by the Bureau much credit is due the daily press of this State, and especially the management of the Southwestern Telegraph and Telephone Company, for the thorough distribution of the warnings to all connecting points without expense to the Bureau.

That these warnings were heeded by the persons affected is evidenced by the following statement, from the flooded district by the correspondent of the Galveston News, under date of August 15, 1902:

"When the news that the overflow was imminent was received every hand was put to work removing all the women, children, stock, implements, and vehicles to places of safety. When this was done the men hitched up their teams and gathered corn and continued to gather it until the water poured into the wagon beds. When forced by the flood to abandon corn some of them turned their attention to the cotton fields. They cut down the entire cotton stalk before the encroaching water and carried it to high ground, hoping that the sun would cause the grown bolls to open and in this way something would be saved. When nothing more could be done in the way of saving a portion of their crops they turned their attention to the houses and anchored them to the ground with cable wire. Others put every hand they could procure to throwing up levees on the low places on the river front, hoping to keep the water back. In these and many other ways the Brazos bottom farmer has helped himself in the present disaster, and has done all that man could do to minimize the loss."

The morning reports of rainfall of the 25th of July gave the first intimation of the probability of a serious flood in the Brazos Valley, excessive rainfalls having been reported from the drainage area of this river as far north as Erath County. Special river observations were immediately called for, and at noon of the 25th the following warning was issued:

"Excessive rains over the drainage area of the Brazos are causing heavy rise in the upper section of that river. Present indications point to flood stages in the upper Brazos River during the next forty-eight hours, and in the middle and lower river within the next three to six days. Notify all interests likely to be affected."

This warning was telegraphed to points in the Brazos Valley, to the superintendent of the Southwestern Telegraph and Telephone Company at Austin, and given to the press for publication.

During the 25th the river at Kopperl rose steadily from a stage of 13.0 feet at the time that the warning was issued to 28.0 feet during the night of that date. It continued at or above the danger line (21 feet) during the 26th, 27th, and 28th, receding to a stage of 8.0 feet on the 29th. At Waco, on the 25th, when the warning was issued, the stage was 11.5 feet. The river at that point rose rapidly during the 25th and 26th, and during the night of the 26th a maximum stage of 34.4 feet was reached, or 10.4 feet above the danger line. On the 26th, the following message was telegraphed to the river observer at Waco for dissemination: "A maximum stage of approximately 36.0 feet will be reached at Waco during the coming night." The breaking of a number of levees south of Waco during the late afternoon and night of the 26th checked the rapid rise at that point, and the maximum stage attained fell 1.6 foot short of that forecast. The river at Waco continued above the danger line during the 26th, 27th, and 28th, and fell to below 24 feet (the danger line) on the 29th. The rise south of Waco was augmented by excessive rains during the 28th and 29th. On the 28th, in anticipation of a continuation of the

heavy downpour, the following warning was issued and disseminated by telegraph, telephone, and through the daily press:

"Excessive rains again falling over the Brazos Valley have caused another rapid rise at Waco and points south thereof. Indications point to a serious overflow at all points south of Waco. Advise public to take precautions to prevent loss of property."

The heaviest damage resulted from this second rise, which was worse in the counties from McLennan southward, including Milam, Bell, Robertson, Brazos, Burleson, Grimes, Washington, Austin, and Waller counties. The crest of the flood passed Navasota on the 3d and Booth on the 8th of August. The highest stage reached at Booth was 38.0 feet. The crest of the flood passed to the Gulf on the 10th of August.

The following rainfalls for the six days, July 25 to 30, inclusive, occurred in the Brazos Valley: Brenham, 9.38 inches; College Station, 5.35 inches; Dublin, 5.58 inches; Hearne, 15.20 inches; Hewitt, 9.93 inches; Kopperl, 8.40 inches; Temple, 14.68 inches; Waco, 7.80 inches. Other rainfalls reported were less than five inches for this period.

The economic aspect of the flood to the Brazos Valley farmer is a serious one. The floods of 1899 and 1900 prevented the maturing of crops in this abnormally productive region, the dreaded boll weevil and drought in 1901 curtailed the crop more than one-half, and the flood this year leaves these people in a deplorable condition financially.

It is not improbable that efforts will now be made to levee the Brazos River. In fact first steps looking to the accomplishment of this purpose have already been taken.

Heavy rains fell in the upper drainage area of the Colorado River between the 20th and 25th of July, the heaviest falls being as follows: Abilene on the 22d and 23d, 4.44 inches; Ballinger on the 21st to 24th, 4.91 inches; Big Springs on the 22d to 24th, 9.89 inches; Colorado on the 20th to 25th, 12.28 inches. On the 26th the following information was telegraphed to the superintendent of the Southwestern Telegraph and Telephone Company at Austin for dissemination to points in the Colorado Valley:

"Rains in the upper Colorado Valley have ceased. While high water will prevail for several days in the middle and lower sections of the Colorado River, no dangerous flood stages are anticipated."

The rise in the Colorado River passed steadily Gulfward, overflowing bottom lands in a number of sections, but without causing damage to any great extent. In the vicinity of Big Springs, in the headwaters of the Colorado River, however, the damage by floods is estimated at \$200,000.

The Trinity, Neches, and Sabine rivers were in flood stage during the last days of July and first decade of August, but as these rivers have their courses through sparsely settled regions, except near their sources, no accurate reports of loss are obtainable.

There was more or less damage in various parts of the State from floods in the minor rivers, a noteworthy one being that of the San Marcos River at San Marcos, Tex., as a result of 9.59 inches of rain having fallen in that vicinity during the 28th and 29th of July.

The Willamette River at Portland, Oreg., was above the danger line of 15 feet from the 5th to the 13th, inclusive, the water coming from the Columbia River. The maximum stage reached was 16.4 feet on the 8th and 9th. Due notice was given, and nothing of unusual interest occurred.

On the first day of the month the River and Flood Service of the Weather Bureau was still further enlarged by the creation of a new district, with headquarters at Sioux City, Iowa. The territory of the new district comprises the entire watershed of the Missouri River above Sioux City, and stations of observation are located on the Missouri River at Townsend and Fort Benton, Mont.; Buford and Bismarck, N. Dak.; Pierre, S. Dak.; and Sioux City, Iowa; on the Yellowstone River at Glendive, Mont.; and on the James River at Lamoure, N. Dak., and Huron, S. Dak.

The highest and lowest water, mean stage, and monthly range at 147 river stations are given in Table VII. Hydrographs for typical points on seven principal rivers are shown on Chart V. The stations selected for charting are: Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—H. C. Frankenfield, Forecast Official.